Claims

1. A method of continuously separating a component from a liquid mixture using a membrane unit which comprises at least one membrane stage and is fed with the mixture as feed,

wherein a membrane stage comprises at least of a conveying device, multiple membrane modules that are connected in series to one another and a feed vessel upstream of the conveying device, and wherein the mixture is guided from the feed vessel by means of the conveying device as feed to the multiple membrane modules, which results in reduction of the component to be separated off, based in each case on the mixture guided to the respective membrane module, in the resulting permeate stream from this respective membrane module and enrichment in the resulting retentate stream from this respective membrane module or vice versa, wherein

the overall permeate stream obtained from the last membrane stage is divided and a portion of the overall permeate stream, the recycled permeate, is recycled to the feed vessel and/or beyond the feed vessel but upstream of the conveying device and the other portion of the overall permeate stream, the permeate removed, is conducted out of the last membrane stage and out of the membrane unit on the permeate side, wherein the recycling of the recycled permeate to the feed vessel and/or beyond the feed vessel but upstream of the conveying device is effected not by means of a conveying device but by hydraulic means, that is, by means of a pressure differential that exists between the permeate side of the membrane unit and the suction side of the conveying device or the feed vessel; and wherein the component is a homogeneous catalyst which is separated from a reaction mixture.

2. The method according to claim 1, wherein the mass flow rate of one of the three streams selected from feed to the membrane unit, the permeate removed, and the retentate from the membrane unit is applied to a preceding or downstream process step, and one further stream of the three is controlled toward a target value.

3. The method according to claim 1, wherein the mass flow rate of the permeate recycled can fluctuate and is established depending on the mass flow rate of the permeate removed.

4. The method according to claim 1, wherein the pressure on the retentate side and/or the pressure on the permeate side or the resulting transmembrane pressure and optionally the membrane module temperature are controlled in order to obtain a desired amount of the overall permeate stream.

5. The method according to claim 1, wherein both the mass flow rate of the permeate removed and the permeate pressure are controlled by means of an adjustable flow resistor.

6. The method according to claim 1, wherein the mass flow rate of the permeate removed, depending directly or indirectly on the fill level of the feed vessel, is subject to continuous closed-loop control, a feature of which is that – based on a target value fixed beforehand for the fill level of the feed vessel – the mass flow rate of the permeate removed increases with rising fill level of the feed vessel and the mass flow rate of the permeate removed decreases with falling fill level of the feed vessel.

7. The method according to claim 1, wherein the pressure on the retentate side is controlled by means of the conveying device with which the feed is fed to the multiple membrane modules, and optionally a further actuator.

8. The method according to claim 1, wherein the mass flow rate on the retentate side is controlled by means of a closed-loop mass flow controller on the retentate side comprising at least a mass flow meter and an adjustable flow resistor.

9. The method according to claim 1, wherein the conveying device is a pump.

10. A method of continuously separating a homogeneous catalyst from a liquid reaction mixture using a membrane unit which comprises at least one membrane stage and is fed with the reaction mixture containing the homogeneous catalyst and coming from a reaction zone as feed,

wherein a membrane stage consists at least of a conveying device, multiple membrane modules that are connected in series to one another and a feed vessel upstream of the conveying device, and wherein the reaction mixture is guided from the feed vessel by means of the conveying device as feed to the multiple membrane modules, which results in reduction of the homogeneous catalyst, based in each case on the reaction mixture guided to the respective membrane module, in the resulting permeate stream and enrichment in the resulting retentate stream, wherein

the overall permeate stream obtained is divided and a portion of the overall permeate stream, the recycled permeate, is recycled to the feed vessel and/or beyond the feed vessel but upstream of the conveying device and the other portion of the overall permeate stream, the permeate removed, is conducted out of the at least one membrane stage and out of the membrane unit on the permeate side.

11. The method according to claim 10, wherein the reaction mixture is taken from a reaction zone in which a homogeneously catalysed reaction is being conducted.

12. The method according to claim 11, wherein the homogeneously catalysed reaction is selected from the group of the following reactions: an oxidation, an epoxidation, a hydroformylation, a hydroamination, a hydroaminomethylation, a hydrocyanation, a hydrocarboxylation, a hydrocarbonylation, a hydrocarboxyalkylation, an alkoxycarbonylation, an amination, an ammoxidation, an oximation, a hydrosilylation, an ethoxylation, a propoxylation, a carbonylation, a telomerization, a metathese, a Suzuki coupling and a hydrogenation.

13. The method according to claim 12, wherein the homogeneously catalysed reaction is a hydroformylation.

14. The method according to claim 2, wherein the mass flow rate of the permeate recycled can fluctuate and is established depending on the mass flow rate of the permeate removed.

15. The method according to claim 2, wherein the pressure on the retentate side and/or the pressure on the permeate side or the resulting transmembrane pressure and optionally the membrane module temperature are controlled in order to obtain a desired amount of the overall permeate stream.

16. The method according to claim 2, wherein both the mass flow rate of the permeate removed and the permeate pressure are controlled by means of an adjustable flow resistor.

17. The method according to claim 2, wherein the mass flow rate of the permeate removed, depending directly or indirectly on the fill level of the feed vessel, is subject to continuous closed-loop control, a feature of which is that – based on a target value fixed beforehand for the fill level of the feed vessel – the mass flow rate of the permeate removed increases with rising fill level of the feed vessel and the mass flow rate of the permeate removed decreases with falling fill level of the feed vessel.

18. The method according to claim 1, wherein the pressure on the retentate side is controlled by means of the conveying device with which the feed is fed to the multiple membrane modules, and optionally a further actuator of a supply pressure regulator, or by means of a combination of a manometer and a valve on the retentate side.

19. The method according to claim 1, wherein the mass flow rate on the retentate side, retentate mass flow rate, is controlled by means of a closed-loop mass flow controller on the retentate

side comprising at least a mass flow meter and a combination of mass flow meter and conveying device.

20. The method according to claim 1, wherein said homogenous catalyst is a transition metal catalyst.